Claims

1. A soil management tool when used in pasture farming systems including an application of nitrification inhibitor in solution form and/or fine particle suspension form and/or as a crystalline form to treat the whole area of grazed pasture soils to reduce at least one of: (1) NO_3^--N leaching; (2) nitrous oxide emissions; (3) potassium, calcium or magnesium leaching; to thereby increase pasture production in both animal urine patch areas and non-urine patch areas of the pasture.

2. A soil management tool when used in pasture farming systems as claimed in claim 1 wherein the nitrification inhibitor is applied in conjunction with either irrigation water, by a spray vehicle or in a similar way to the application of agricultural chemicals.

3. A soil management tool when used in pasture farming systems as claimed in claim 1 or claim 2 wherein the solution and/or fine particle suspension and/or crystalline form of nitrification inhibitor is applied to a grazed dairy pasture in the autumn at a frequency and timing which reduces NO_3^--N leaching by about 76% for urine-N.

4. A soil management tool when used in pasture farming systems as claimed in claim 1 or claim 2 wherein the solution and/or fine particle suspension of nitrification inhibitor is applied to a grazed dairy pasture in the spring at a frequency and timing which reduces NO_3^--N leaching by about 42% for urine-N.

5. A soil management tool when used in pasture farming systems as claimed in claim 3 wherein the solution and/or fine particle suspension of nitrification inhibitor is additionally applied to the grazed dairy pasture in the spring at a frequency and timing which reduces NO_3^--N leaching by about 42% for urine-N thereby giving an annual average reduction of about 59%, which is equivalent to reducing the NO_3^--N leaching loss in a grazed pasture from about 118 to about 46 kg N ha^{-1} y^{-1}.

6. A soil management tool when used in pasture farming systems as claimed in any one of the preceding claims wherein the nitrification inhibitor is dicyandiamide (DCD).

7. A soil management tool when used in pasture farming systems as claimed in any one of claims 1 to 5 wherein the nitrification inhibitor is another type of nitrification inhibitor, such as nitropyrin or 3,4-dimethylpyrazole phosphate (DMPP).

8. A soil management tool when used in pasture farming systems as claimed in any one of the preceding claims wherein the application of nitrification inhibitor in solution form and/or fine particle suspension form promotes permeation of the inhibitor throughout a soil surface layer enabling it to treat a greater soil volume and slowing down its decomposition.

9. A soil management tool when used in pasture farming systems as claimed in any one of the preceding claims wherein multiple applications of nitrification inhibitor are used to maintain the inhibition effect in the soil for a longer time period.

10. A soil management tool when used in pasture farming systems as claimed in any one of the preceding claims wherein the nitrification inhibitor is applied as a crystalline form, either on its own or in combination with other products which allows for rainfall or irrigation to dissolve it into soil.

11. A soil management tool when used in pasture farming systems as claimed in claim 1 and substantially as hereinbefore described with reference to any one of the examples.

12. A delivery mechanism for applying a nitrification inhibitor in solution form and/or fine particle suspension form to the whole area of the soil in a grazed pasture system.

13. A delivery mechanism as claimed in claim 12 wherein the nitrification inhibitor reduces at least one of: (1) NO_3^--N leaching; (2) nitrous oxide emissions; (3) potassium, calcium or magnesium leaching; to thereby increase pasture production in both animal urine patch areas and non-urine patch areas of the grazed pasture system.

14. A delivery mechanism as claimed in claim 12 or claim 13 wherein the nitrification inhibitor is applied in conjunction with either irrigation water, by a spray vehicle or in a similar way to the application of agricultural chemicals.

15. A delivery mechanism as claimed in claim 12 wherein the nitrification inhibitor is supplied to an irrigator by a computer controlled system at a concentration dependent on the level of control required over the processes in the soil.

16. A delivery mechanism as claimed in claim 15 wherein the nitrification inhibitor is injected from a supply tank into irrigation water using a flow rate controlled pump connected to a irrigation delivery pipe or irrigation hose.

17. A delivery mechanism as claimed in claim 12 and substantially as hereinbefore described with reference to Examples 2 and 3 and the accompanying drawings.

18. A method of improving pasture production in a grazed pasture by applying a nitrification inhibitor, the method including the step of applying the nitrification inhibitor in a solution and/or fine particle suspension form to the whole area of the grazed pasture soil to thereby reduce at least one of: (1) NO_3^--N leaching; (2) nitrous oxide emissions; (3) potassium, calcium or magnesium leaching in both animal urine patch areas and non-urine patch areas of the grazed pasture system.

19. A method as claimed in claim 18 wherein the NO_3^--N concentration in a drainage water from the grazed dairy pasture soil is reduced from about 19.7 to about 7.7 mg N L^{-1}.

20. A method as claimed in claim 18 or claim 19 wherein a solution of nitrification inhibitor (DCD) when applied at a frequency and timing to the grazed pasture increases pasture production from the whole of the grazed pasture by more than 15%.

21. A method as claimed in any one of claims 18 to 20 wherein the application of DCD reduced total annual NO_3^--N leaching loss from about 488 to about 112 kg N ha^{-1} y^{-1}.

22. A method as claimed in any one of claims 18 to 21 wherein after a urine application in the spring the application of DCD reduced total annual NO_3^--N leaching loss from about 397 to about 230 kg N ha^{-1} y^{-1}.

23. A method as claimed in claim 21 wherein after a urine application in the spring the application of DCD reduced total annual NO_3^--N leaching loss from about 397 to about 230 kg N ha^{-1} $y^{-1}$and that the application of DCD reduced NO_3^--N leaching by an average of 76.1% for the urine-N applied in the autumn, and by 42.1% for the urine N applied in the spring.

24. A method as claimed in any one of claims 18 to 20 with the addition of urea applied at 200 kg N ha^{-1} y^{-1} throughout the pasture and the pasture was grazed by about 3 cows per ha, the average annual NO_3^--N leaching loss was reduced from about 118 to about 46 kg N ha^{-1} y^{-1} when DCD was applied to the whole area of the grazed pasture soil.

25. A method as claimed in any one of claims 18 to 24 wherein the increases in pasture N off-take as a result of DCD application were equivalent to about 23% for the autumn urine treatments, and about 9% for the spring urine treatments, giving an annual average of about 16%.

26. A method as claimed in any one of claims 18 to 25 wherein pasture yields increased from about 11.1 to about 13.0 t ha^{-1} y^{-1} when DCD was applied to the whole area of the grazed pasture soil.

27. A method as claimed in any one of claims 18 to 26 wherein DCD is applied 5 times in a spring urine treatment compared to 9 applications in an autumn urine treatments.

28. A method as claimed in any one of claims 18 to 26 wherein DCD is applied in two applications per year (e.g. spring and autumn).

29. A method as claimed in any one of claims 18 to 28 wherein the use of DCD reduced NO_3^--N leaching by about 76% for the urine N applied in the autumn, and by about 42% for urine N applied in the spring, giving an annual average reduction of about 59% to thereby reduce the NO_3^--N leaching loss in the whole area of a grazed paddock from about 118 to about 46 kg N ha^{-1} y^{-1}.

30. A method as claimed in any one of claims 18 to 29 wherein application of DCD resulted in a reduction in the NO_3^--N concentration in the drainage water from about 19.7 to about 7.7 mg N L^{-1}.

31. A method as claimed in claim 30 wherein the use of DCD increased pasture production by more than 15% %, from about 11.1 to about 13.0 t ha^{-1} y^{-1}.

32. A method as claimed in any one of claims 18 to 31 wherein the application of the nitrification inhibitor reduced calcium (Ca^{2+}) leaching by about 50% (from about 213 to about 107 kg/ha/y), reduced potassium (K^+) leaching by about 65% (from about 48 to about 17 kg/ha/y) reduced magnesium (Mg^{2+}) leaching by about 52% (from about 17 to about 8 kg/ha/y).

33. A method as claimed in any one of claims 18 to 31 wherein the application of the nitrification inhibitor reduced nitrous oxide emissions following urine application in autumn from about 26.7 kg N_2O-N ha^{-1} without DCD to about 7.0 kg N_2O-N with DCD applied.

34. A method as claimed in any one of claims 18 to 31 wherein the application of the nitrification inhibitor reduced nitrous oxide emissions following urine application in spring from about 18.0 kg N_2O-N ha^{-1} without DCD to about 4.5 kg N_2O-N ha^{-1} with DCD applied.

35. A method of improving pasture production in a grazed pasture by applying a nitrification inhibitor substantially as hereinbefore described with reference to the examples.